1 Statement of Work

1.1 Progress and Upcoming Work

We have made continued progress in the second year of this grant. Using the work of Miyamoto and Zolensky (1994) relating the integrated intensity of the 3-μm absorption band to the H:Si ratio, and the work of Sato *et al.* (1997) relating the 2.9/2.5 μm reflectance ratio to the integrated intensity, we have determined the water content of the regolith of several large C-class asteroids, and have a paper to be submitted to *Meteoritics and Planetary Sciences* in February. (see Figures 1 and 2, and preprint attached). We have found that the water contents of these asteroids are lower than the water content of CM meteorites, but are within a factor of two or less in general. We have also found that the 0.7-μm band depth from phyllosilicates (Vilas and Gaffey, 1989) correlates with the 3-μm band depth, though perhaps in a complicated way. Figure 2 shows the amount of water inferred for objects already in hand compared to asteroids. Interestingly, we find that the G-class asteroids in our sample have water contents consistent with the CM meteorites, strengthening a link between these groups proposed by Burbine (1998).

Five nights were obtained on the IRTF during 2002 for this project. These data are undergoing analysis, but we had excellent weather conditions, and expect the data quality will be good. Observations of 2002 NY40, which was a very close Earth-approaching asteroid, were made through this program, and a paper on that object is expected (LPSC abstract is included).

1.2 Publications Partially or Wholly Supported by This Grant

The following work has also been achieved this year, supported by this and other grants:

- "Infrared Spectrophotometry of Phobos and Deimos" A. S. Rivkin, R. H. Brown, D. E. Trilling, J. F. Bell III and J. H. Plassmann (2002), *Icarus*, **156**, pp. 64-75.
- "Hydrated Minerals on Asteroids: The Astronomical Record" A. S. Rivkin, E. S. Howell, F. Vilas, and L. A. Lebofsky (2002), to be included as a chapter in *Asteroids III*
- "Hydrogen Concentrations on C-class Asteroids from Remote Sensing" A. S. Rivkin, J. K. Davies, J. R. Johnson, S. L. Ellison, D. E. Trilling, R. H. Brown, and L. A. Lebofsky (2003), to be submitted to *Meteoritics and Planetary Sciences*, Feb. 2003.
- "Spectroscopy and Photometry of the Earth Grazer 2002 NY40" A. S. Rivkin, E. S. Howell, M. Hicks, W. T. Reach, T. H. Jarrett, and R. P. Binzel (2003), to be presented at the Lunar and Planetary Science conference in Houston in March.

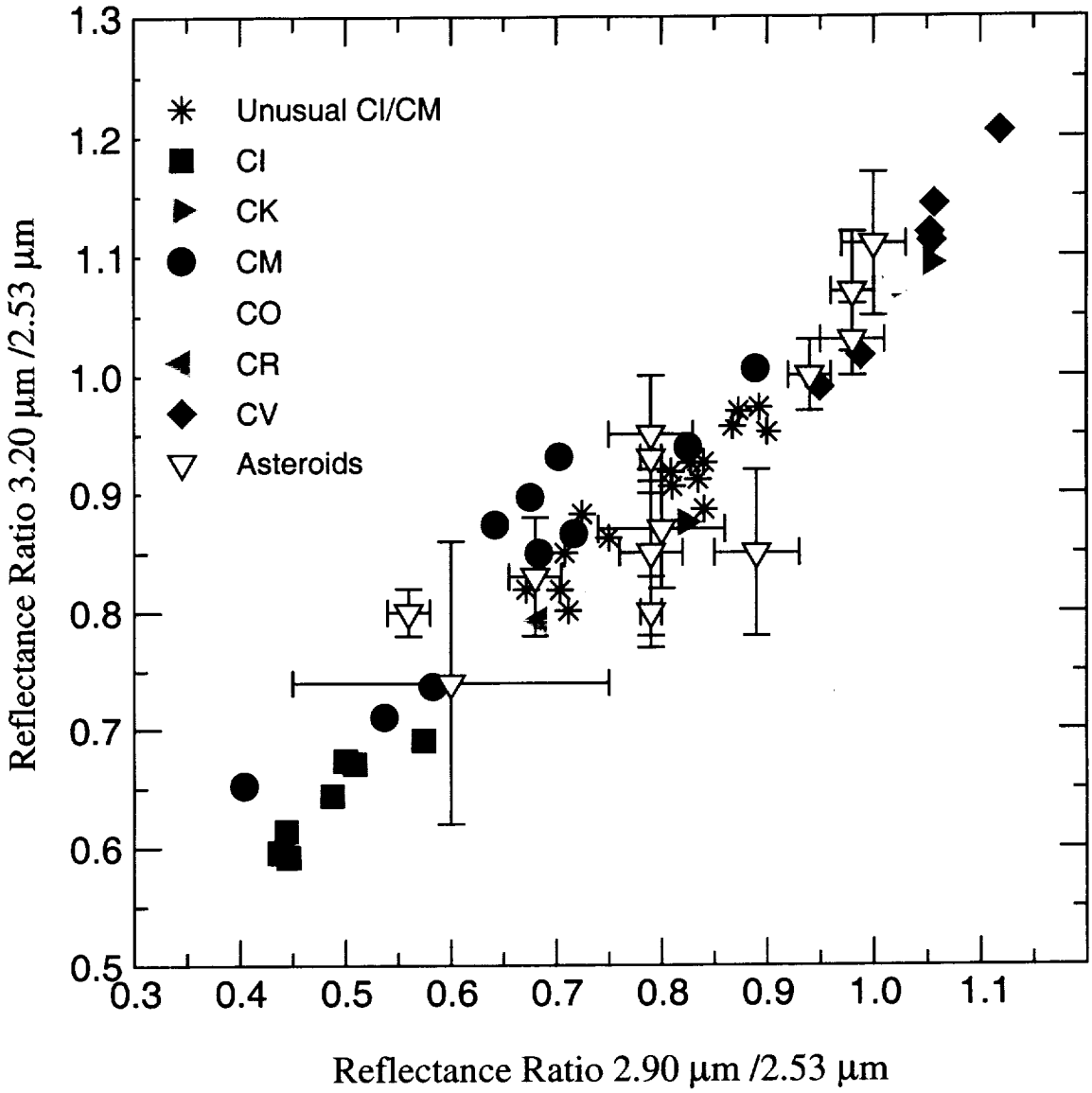

Figure 1. Reflectance ratios for carbonaceous chondrite meteorites and C-class asteroids in the 3-μm region. Most of the asteroids fall along the trend defined by the meteorites, showing that their reflectance spectra are similar and suggesting their mineralogies are similar. The meteorite data are from Hiroi *et al.* (1996), the asteroid data are being analyzed as part of this program.

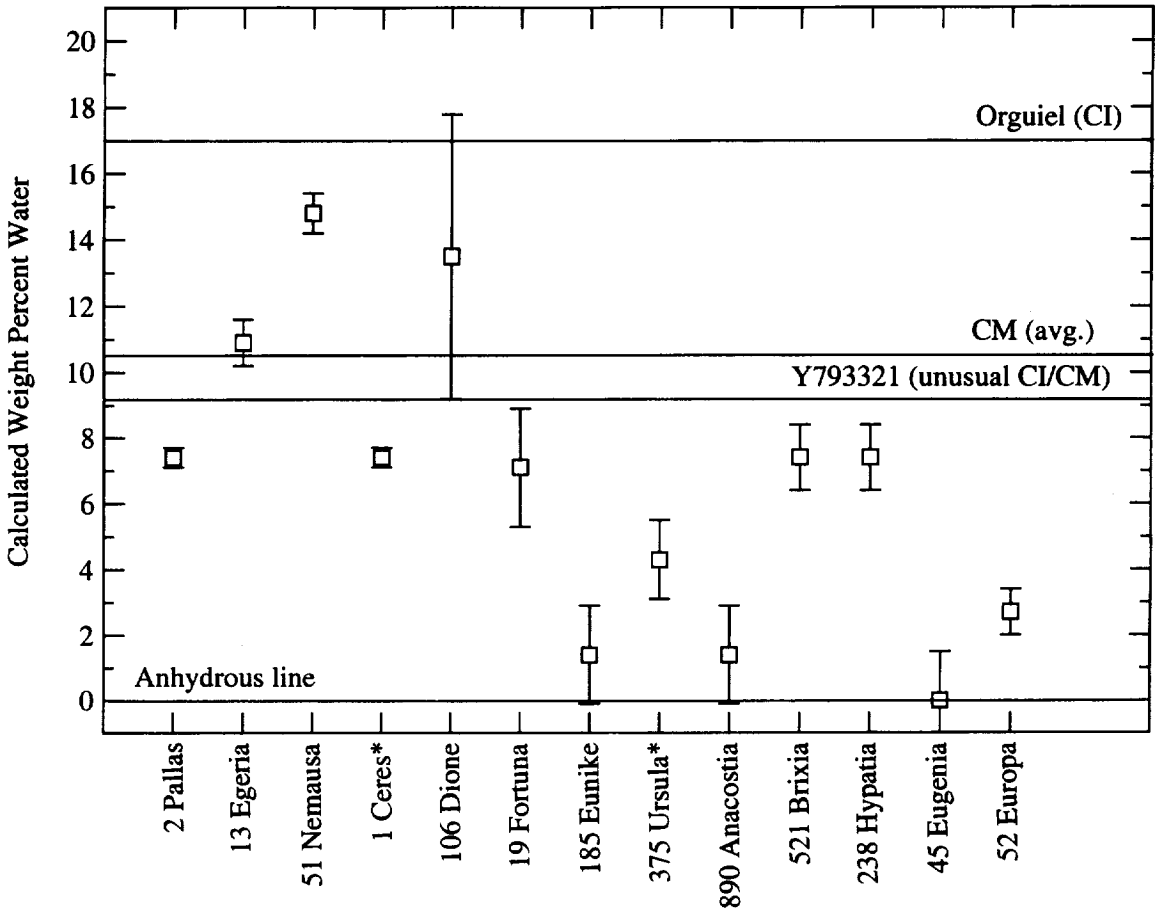

Figure 2. Calculated water contents for C-class asteroids. Because we can relate the 3-μm absorption band depth to the H:Si ratio in meteorites (Miyamoto and Zolensky, 1994), we can (in principle) do the same with asteroids, given an assumption about the weight percent of Si. If we assume a CM-like bulk Si concentration, the following water concentrations (in weight percent) are derived. This explicitly assumes all the hydrogen is in water rather than in OH, for consistency with reported meteoritical values (Jarosewich, 1990). The asteroids have less water in general than the CM meteorites by about one-third. However, three asteroids (Egeria, Nemausa, and Dione) have water contents consistent with the CM values.

2 References

References

Burbine, T. H. (1998). Could G-class asteroids be the parent bodies of the CM chondrites? *Meteoritics and Planetary Science* **33**, 253–258.

Hiroi, T., M. E. Zolensky, C. M. Pieters, and M. E. Lipschutz (1996). Thermal metamorphism of the C, G, B, and F asteroids seen from the 0.7 μm, 3 μm and UV absorption strengths in comparison with carbonaceous chondrites. *Meteoritics and Planetary Science* **31**, 321–327.

Jarosewich, E. (1990). Chemical analyses of meteorites: A compilation of stony and iron meteorite analyses. *Meteoritics* **25**, 323–337.

Miyamoto, M. and M. E. Zolensky (1994). Infrared diffuse reflectance spectra of carbonaceous chondrites: Amount of hydrous minerals. *Meteoritics* **29**, 849–853.

Sato, K., M. Miyamoto, and M. E. Zolensky (1997). Absorption bands near three micrometers in diffuse reflectance spectra of carbonaceous chondrites: Comparison with asteroids. *Meteoritics and Planetary Science* **32**, 503–507.

Vilas, F. and M. J. Gaffey (1989). Phyllosilicate absorption features in main-belt and outer-belt asteroid reflectance spectra. *Science* **246**, 790–792.